The physical properties of inorganic crystalline materials can be dramatically transformed by controlled introduction of impurities or other defects, without which most semiconductor technologies including transistors, diodes, and solar cells would not be possible. This talk will describe some of our group's recent research into understanding, controlling, and exploiting the physical properties of doped colloidal quantum dots. New chemistries for introducing dopants into quantum dots and for measuring their impact on physical properties will be described, and the unique redox, spectroscopic, or photophysical properties of various types of doped colloidal nanostructures will be discussed.